



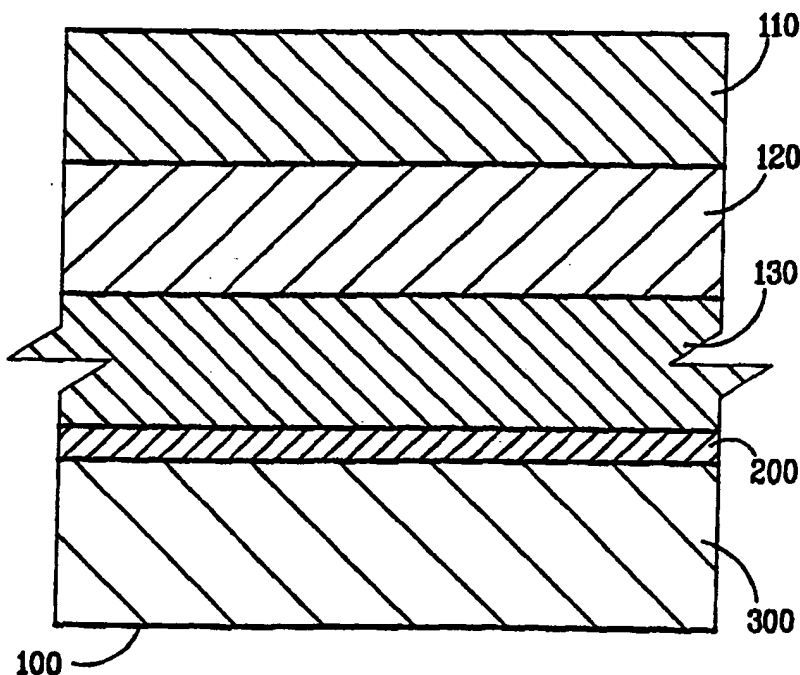
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(54) Title: MULTI-LAYER FILM WITH ENHANCED LAMINATION BOND STRENGTH

(57) Abstract

A laminated film structure that includes a primary web having migratory additive in the first outer layer (110) and as second outer layer (130) comprising a single site catalyzed polyethylene, such as one made by a metallocene catalysis. The second outer layer can be laminated to the surface of a second web (200) without the need for treating the surface of the second outer layer with a primer or solvent. The primary web, further includes a core substrate (120) layer disposed between the two outer layers, such as bi-axially oriented polypropylene layer. The resulting structures have improved bond strength between the primary web and the secondary web.



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MULTI-LAYER FILM WITH
ENHANCED LAMINATION BOND STRENGTH

5 This invention relates to the field of polymer films containing migratory additives that can be laminated to other films and methods for forming such films. In particular, this invention relates to a film having a first outer layer containing a migratory additive, such as silicone oil, and a second outer layer containing a metallocene polyethylene that can be laminated to another film structure.

10 Multiple layer films are commonly used in the packaging industry for a variety of food products, such as potato chips, cookies, candies and other snack foods. These films can be formed by coextrusion methods or by laminating two or more films together. Many laminated films use oriented polypropylene (OPP) in the core layer because of its durability and strength. Different surface layers are selected for the interior and exterior layers of the package that are
15 suitable for the particular product. For example, chips may have one type of inner layer, while wrapped candies may have a different type of inner layer. Similarly, the outer layer may be selected to enhance printability, clarity, gloss or other characteristics of the film. Frequently, additives are used to impart the desired characteristics to the outer layer.

20 The use of migratory additives to impart specific properties to the outer layers of multiple layer packaging films to improve specific film characteristics is well known in the art. These additives are often added to the thermoplastic resins before the film is extruded and only migrate to the surface (i.e., bloom) after the film is formed. When these migratory additives bloom to the surface of the outer layer, they promote the desired characteristics on the film
25 surface. Often, the additive is a silicone oil. Silicone oils are added to an exterior layer of a film to improve its coefficient of friction in the heated state and reduce its slide resistance which occurs during hot plate seal by an automatic packaging machine. Examples of silicone oils which are useful for this purpose are olefin-modified silicone, polydimethylsiloxane, polymethylphenylsiloxane, polyether (e.g., polyethylene glycol, polypropylene glycol)-
30 modified silicone, olefin/polyether-modified silicone, epoxy-modified silicone, etc.

The presence of a migratory additive on the surface of an exterior layer of a film can create problems when the film is used for an application that requires the opposing, untreated

exterior surface of the film to be devoid of the additive. The untreated exterior surface is contacted by the additive when the film is rolled and subsequently unrolled. Rolling the film brings the treated exterior surface in contact with the untreated exterior surface and the additive is transferred. In order for the film to be used in an application that requires the untreated exterior layer to be devoid of the additive, the additive must first be removed. When the migratory additive is a silicone oil that has been added to improve the film's coefficient of friction and reduce its slide resistance, the characteristics that are desirable for the treated exterior surface are undesirable for the untreated exterior surface. Silicone oil on the untreated exterior surface is especially undesirable when the surface is to be laminated to another structure.

The key step in laminating is the creation of strong adhesive bonds between the films. To assure the formation of strong adhesive bonds, the adhesives must be compatible with the materials on the surfaces of the opposing films. While silicone oils impart useful properties to a film, film surfaces containing silicone oil have been found to have poor adherence when laminated to another film structure. In the past, this problem has been overcome by applying a primer (typically in the form of a solvent) to the film prior to lamination. In addition to the cost of the solvent, this method adds an additional step to the manufacturing process and is, therefore, more costly and undesirable. This has created a need for a film that does not require the application of a primer to neutralize silicone oil prior to lamination.

The films of the present invention find their principal utility as a structure that can be laminated to other film layers. However, it is to be understood that these films can also be used independently as a stand alone packaging material without adding additional layers.

The present invention provides a film structure made up of a primary web that includes a migratory additive in one outer layer and a metallocene polyethylene in a second outer layer that has an interior and an exterior surface. Unlike prior art films, the metallocene polyethylene outer layer can be laminated to a secondary web without having to treat the surface with a primer or solvent. The primary web film structure can also include a core substrate layer disposed between the first outer layer and the second outer layer. The interior surface of the second outer layer is adjacent to the core substrate layer and the exterior surface is laminated to a secondary web.

The migratory additive used in the first outer layer is selected from the group made up of silicone oil, polydialkylsiloxanes, polydimethylsiloxane, polyalkylphenylsiloxanes, olefin-modified siloxane oils, polyether-modified silicone oils, olefin/polyether-modified silicone
5 oils, epoxy-modified silicone oils, alcohol-modified silicone oils, antiblocking agents, antistatic agents, and slip agents. Preferred silicone oils have a viscosity of from 350 to 100,000 centistokes and the most preferred silicone oils have a viscosity of from 10,000 to 30,000 centistokes.

10 The first outer layer can also include a polyolefin selected from the group made up of homopolymers of ethylene, propylene and butylene, and copolymers and terpolymers of ethylene, propylene and/or butylene. The migratory additive in the first outer layer can be a silicone oil or the additive can be selected from the group made up of antiblocking agents, antistatic agents, and slip agents. In preferred embodiments, the first outer layer can include
15 more than one migratory additive.

The films of the present invention can be laminated to other film structures without being pretreated prior to lamination. Specifically, the second outer layer of the primary web does not have to be treated with a primer to remove or neutralize the migratory additive from
20 the surface.

The second outer layer includes a metallocene polyethylene that can be selected from the group made up of ethylene homopolymers, copolymers of ethylene and at least one C₄-C₂₀ alpha-olefin polymerized using single-site metallocene catalyst, wherein the alpha olefin has a
25 molecular weight distribution (Mw/Mn) below 5.5, preferably below 3.5 and most preferably below 3.0, and a Melt Index at 190 C and 2160 g of from 0.3 to 20 dg/min, preferably 0.8 to 10 dg/min and most preferably from 1.2 to 7 dg min. More specifically, the metallocene polyethylene can be selected from the group made up of linear low density polyethylene, very low density polyethylene, ultra low density polyethylene, polyethylene plastomers and blends
30 thereof.

In addition to the metallocene polyethylene, the second outer layer can also include a polyolefin selected from the group made up of blends of 1% to 99% by weight of metallocene-

based polyethylene and 99% to 1% by weight of Ziegler-Natta catalyzed ethylene homopolymers or copolymers and homopolymers and copolymers of propylene and butylene

5 The metallocene polyethylene can include an additive selected from the group made up of 0.2 to 20 weight % high density polyethylene, 1 to 6,000 ppm spherical antiblock, 1 to 6,000 ppm random shape antiblock, antistatic agents and slip agents.

10 The core substrate layer includes a polyolefin selected from the group made up of oriented polypropylene, high density polyethylene, and blends of polypropylene and polyethylene.

15 The primary web of the film structures of the present invention can be laminated to a secondary web without pretreatment even though the laminated layer of the primary web contains a migratory additive, such as silicone oil, on the surface. Prior art film webs that contain migratory additives must be pretreated to remove the migratory additive from the surface that is to be laminated. If the migratory additive is not removed, the prior art webs will not form satisfactory bonds when laminated. In contrast, it has been found that the metallocene polyethylene copolymer outer layers in the primary web of the present invention can be laminated to a secondary film web without removing or treating the migratory additive on the surface. The laminated structures of the present invention have a bond strength between the primary web and the secondary web that is comparable to prior art that are treated with a primer prior to lamination. Consequently, the film structures of the present invention provide a savings in processing time and costs by eliminating the prelamination treatment step.

25 Figure 1 is a cross-section of a three layer primary web of the present invention.

Figure 2 is a cross-section of a laminated film structure of the present invention that includes a primary web laminated to a secondary web.

30 The multiple layer films of the present invention overcome the problems encountered in prior art films that contain migratory additives by eliminating the need to treat the surface of the films with a primer prior to lamination. The present invention is based on the discovery that metallocene polyethylene film layers contacted by migratory additives, such as silicone

oil, can be laminated without first being treated with a primer. It has been found that migratory additives that interfere with lamination bonding in prior art structures do not have the same effect on metallocene polyethylene film layers. The film structures of the present invention include an outer layer containing a metallocene polyethylene that provides acceptable lamination adhesion when a migratory additive is present on the surface.

For the purposes of this disclosure and, the following definitions are adopted:

Primary Web: The films of the present invention that have at least one layer containing a migratory additive and one layer containing a metallocene polyethylene.

Secondary Web: When the films of the present invention are laminated to a second film structure, the second film structure is the secondary web.

Binder: An adhesive that is used to laminate a primary web to a secondary web to form a laminated film structure. This term can be used interchangeably with the term "lamination adhesive."

Laminated Film Structure: The film that is formed by laminating the primary web to the secondary web. In addition to the primary web and the secondary web, the laminated film structure can include additional laminated film layers.

First Outer Layer or Layer (a): The outer layer of the primary web that contains a migratory additive. When the film is laminated to another film, this layer forms an outer layer of the laminated structure.

Second Outer Layer or Layer (c): The outer layer of the primary web that contains a metallocene polyethylene. When the film is laminated to another film, the lamination adhesive contacts this layer. This layer forms an inner layer of the laminated structure.

Core Layer or Layer (b): The layer disposed between the First Outer Layer and the Second Surface Layer of the primary web. In some embodiments of the present invention, there can be intervening layers between the Core Layer and the two outer layers.

The primary web of the film structures of the present invention has at least two layers.

The first layer contains a migratory additive and the second layer contains a
5 metalocene polyethylene. Figure 1 illustrates a preferred embodiment in which the primary web 100 has three layers including a core layer 120 containing an oriented polypropylene and a first outer layer 110 and a second outer layer 130. The primary web 100 shown in Figure 1 can be used for packaging food products or it can be laminated to another film structure.

10 As illustrated in Figure 2, the primary web 100 can be laminated to a secondary web 300 using a binder 200 to form a laminated film structure 10. When the films are laminated, the metalocene polyethylene layer 130 of the primary web 100 is bonded to the secondary web 300. Unlike prior art films that contained migratory additives, the primary web 100 of the films of the present invention do not have to be treated with a primer before they can be
15 laminated. It has been found that the metalocene polyethylene copolymers in the second outer layer 130 are not effected by the migratory additives in the same way as the polymers used in prior art films. Migratory additives, such as silicone oils, can be present on the surface of the outer layer 130 and the primary web 100 can be successfully laminated to a secondary web 300. When compared to prior art films, the laminated film structures 10 of the present
20 invention have superior bond strength between the primary web 100 and the secondary web 300.

The first outer layer (a) 110 of the primary web 100 includes a polyolefin selected from the group made up of homopolymers of ethylene, propylene or butylene, and copolymers and
25 terpolymers of ethylene, propylene and/or butylene. Preferred polyolefins are an ethylene-propylene-butene-1 (EPB) terpolymer, an ethylene-propylene (EP) random copolymer or a blend thereof. Suitable EPB terpolymers are those obtained from the random interpolymerization of from 1 to 8 weight percent ethylene, preferably from 3 to 6 weight percent ethylene with from 65 to 95 weight percent propylene, preferably from 86 to 93 weight
30 percent propylene, butene-1 representing the balance. The EPB terpolymers are for the most part characterized by a melt index at 230°C of from 2 to 16 and advantageously from 3 to 7, a crystalline melting point of from 100°C to 120°C, an average molecular weight of from 25,000 to 100,000 and a density within the range of from 0.89 to 0.92 gm/cm³.

The EP random copolymers contain from 2 to 7 weight percent ethylene, the balance being made up of propylene. The copolymers can have a melt index at 230°C ranging from 2 to 15 and preferably from 3 to 8. The crystalline melting point is from 125°C to 150°C and the
5 number average molecular weight range is from 25,000 to 100,000. The density range is from 0.89 to 0.92 gm/cm³.

In general, where blends of EPB terpolymer and EP random copolymer are used, the blends contain from 10 to 90 weight percent EPB terpolymer and preferably from 40 to 60
10 weight percent EPB terpolymer, the balance being made up of EP random copolymer.

The outer layer (a) 110 includes a migratory additive which is selected from the group made up of silicone oil, polydialkylsiloxanes, polydimethylsiloxane, polyalkylphenylsiloxanes, olefin-modified siloxane oils, polyether-modified silicone oils, olefin/polyether-modified
15 silicone oils, epoxy-modified silicone oils, alcohol-modified silicone oils, antiblocking agents, antistatic agents, and slip agents.

In a preferred embodiment, the polymer constituting outer layer (a) 110 is compounded with a silicone oil. The silicone oil typically possesses a viscosity of from 350 to 100,000
20 centistokes with from 10,000 to 30,000 centistokes being especially preferred. Examples of suitable silicone oils are polydialkylsiloxanes, polyalkylphenylsiloxanes, olefin-modified siloxane oils, polydimethylsiloxanes, polyether-modified silicone oils, olefin/polyether-modified silicone oils, epoxy-modified silicone oils and alcohol-modified silicone oils. In particular, polydialkylsiloxanes having from 1 to 4 carbon atoms in the alkyl group, in
25 particular polydimethylsiloxane, are preferred.

The silicone oil can be added to outer layer (a) 110 in the form of a dispersion or emulsion, the silicone being present within and on the exposed surface of this layer as discrete microglobules, frequently of an average size of from 1 to 2 microns. The silicone oil is
30 substantially uniformly distributed on the exposed surface of outer layer (a) and is responsible for imparting a reduced coefficient of friction to this surface. Silicone oil is transferred from the exposed surface of outer layer (a) 110 to the exposed surface of outer layer (c) 130 when

the surfaces have been placed in mutual contact, e.g., as will occur when the primary web 100 is wound on a winding coil.

Polydimethylsiloxane or other silicone oil can be present in an amount of from 0.15 to 1.5 weight percent of the first outer layer (a) 110. Some of the silicone oil can also be present on the exposed surface of outer layer (c) 130. The amount of silicone oil in outer layer (a) 110 should be sufficient to provide a coefficient of friction for outer layer (a) 110 (following transfer of some of the silicone oil microglobules to outer layer (c) 130) of 0.4 or less, preferably between 0.25 to 0.3 up to 60°C.

The silicone oil should be incorporated as homogeneously as possible in the polymer constituting outer layer (a) 110. This can be achieved by either incorporating the silicone oil as a dispersion or emulsion at room temperature and then heating the blend with the application of shearing forces or by incorporating the oil while the blend is being melted. The mixing temperature must be high enough to soften the blend and enable a very uniform mixture to be formed. The temperature required in a kneader or extruder is generally from 170°C to 270°C.

In order to enhance its receptivity for water-based coatings, outer layer (a) 110 can be treated by such known and conventional techniques as corona discharge and flame treating.

Core layer (b) 120 of the primary web 100 includes a polyolefin selected from the group made up of oriented polypropylene, high density polyethylene, and blends of polypropylene and polyethylene. Preferably core layer (b) 120 contains a polypropylene of high stereoregularity that can be chosen from among the highly isotactic polypropylenes. The preferred polypropylenes are well known in the art and are formed by polymerizing polypropylene in the presence of stereospecific catalyst systems. The polypropylenes can have a melt index at 230°C ranging from 1.0 to 25.0. The crystalline melting point is 160°C. The number average molecular weight ranges from 25,000-100,000 and the density ranges from 0.90 to 0.91g/cm³.

Second outer layer (c) 130 of the primary web includes a metallocene polyethylene that can be selected from the group made up of ethylene homopolymers, copolymers of ethylene and at least one C₄-C₂₀ alpha-olefin polymerized using single-site metallocene catalyst,

wherein the alpha olefin has a molecular weight distribution (M_w/M_n) below 5.5, preferably below 3.5 and most preferably below 3.0, and a Melt Index at 190 C and 2160 g of from 0.3 to 20 dg/min, preferably 0.8 to 10 dg/min and most preferably from 1.2 to 7 dg min. More specifically, the metallocene polyethylene can be either linear low density polyethylene, very low density polyethylene, ultra low density polyethylene, polyethylene plastomers or blends thereof.

In addition to the metallocene polyethylene, the second outer layer (c) 130 can include blends of 1% to 99% by weight of metallocene-based polyethylene and 99% to 1% by weight of Ziegler-Natta catalyzed ethylene homopolymers or copolymers and homopolymers and copolymers of propylene and butylene

The metallocene polyethylene can include an additive selected from the group made up of 0.2 to 20 weight % high density polyethylene, 1 to 6,000 ppm spherical antiblock, 1 to 6,000 ppm random shape antiblock, antistatic agents and slip agents.

The metallocene polyethylene is a polyethylene formed using single-site metallocene catalyst technology. More specifically, a polyethylene formed using well known single-site metallocene catalyst technology, such as disclosed in U.S. Pat. No. 5,324,800, and having a density range of 0.890 to 0.945 g/cc, and a peak melting point range of 85°C to 123°C (185°F to 255°F). Preferably, the second outer layer (c) 130 is a very-low-density polyethylene having a density of 0.910 g/cc and a peak melting point of 107.8°C (226°F). A preferred very low density polyethylene is sold by Dow Plastics, Dow U.S.A., Midland, Mich., under the trademark AFFINITY, especially the AFFINITY PL1845 copolymer.

The metallocene polyethylene can also be an ultra low density polyethylene plastomer having a density of 0.865 to 0.889 g/cc and a peak melting point range of 48.9 to 85°C (120°F to 185°F). Polyethylene plastomers are formed using well known single-site metallocene catalyst technology, which permits very precise control of comonomer which may be incorporated into the polyethylene polymer and of molecular weight distribution. The plastomers are homopolymers of ethylene, or copolymers of ethylene with higher alpha-olefins having from 3 to 10 carbon atoms such as 1-butene, 1-hexene and 1-octene. The plastomers are commercially available from Dow Plastics, Dow U.S.A., Midland, Mich., under the

trademark ENGAGE, especially ENGAGE EG8100 (an ethylene/1-octene copolymer). The ENGAGE plastomers have a density range of 0.865 to 0.889 g/cc and a peak melting point range of 48.9 to 85°C (120°F to 185°F). Suitable plastomers also are available from Exxon Chemical Americas, Polymer Group, under the trademark EXACT. The EXACT plastomers have similar density and peak melting point ranges as defined for the Dow plastomers.

The primary web 100 of the present invention can have various combinations of layers. Core layer (b) 120 of the primary web 100 can make up from 70 to 90 percent of the thickness of the overall film, or in some embodiments an even higher percentage thereof. First outer layer (a) 110 and second outer layer (c) 130 are coextensively applied to each major surface of core layer (b) 120, preferably as a coextrusion. For example, the individual polymer streams constituting the materials of layers (a) 110, (b) 120 and (c) 130 can be coextruded from a conventional extruder through a flat sheet die, the melt streams being combined in an adapter prior to being extruded from the die. Each of outer layers (a) 110 and (c) 130 can make up, for example, approximately 6.0% of the total thickness of the primary web 100. After leaving the die orifice, the coextruded primary web is chilled and the quenched sheet is then heated and stretched, e.g., five times in the machine direction (MD) and eight times in the transverse direction (TD). Table 1 below lists several preferred structures for the primary web 100.

TABLE 1
THREE LAYER FILM STRUCTURES
(PRIMARY WEB)

Film No.	First Outer Layer Layer (a)	Core Layer Layer (b)	Second Outer Layer Layer (c)
1	EPB Terpolymer	Polypropylene	Dow Affinity PL 1840
2	EPB Terpolymer	Polypropylene	Dow Affinity PL 1845
3	EPB Terpolymer	Polypropylene	Dow Affinity PL 1850
4	EPB Terpolymer	Polypropylene	Mobil ZCE 200
5	EPB Terpolymer	Polypropylene	Exxon Exact 3034

Where:

EPB Terpolymer: Ethylene-Propylene-Butene Terpolymer compounded with
24,000 ppm silicone oil (Chisso 7502, 7702 or 7820)

Polypropylene: Fina 3371

Dow Affinity PL 1840: Metallocene Polyethylene, density = 0.909 g/cc

5 Dow Affinity PL 1845: Metallocene Polyethylene, density = 0.910 g/cc

Dow Affinity PL 1850: Metallocene Polyethylene, density = 0.902 g/cc

Mobil ZCE 200: Metallocene Polyethylene, density = 0.918 g/cc

10 The primary web 100 is preferably used as a laminate layer of a laminated film structure 10. The primary web 100 can be laminated to a variety of different film structures that can include paper, thermoplastic, metallized and foil layers. Table 2 lists preferred embodiments of the laminated film structures 10 of the present invention. The laminated film structures 10 shown in Table 2 include a primary web 100 laminated to a secondary web 300 using a binder 200.

15

A binder 200 is used in the lamination process to adhere the primary web 100 to the secondary web 300. The binder 200 can be applied by well known coating methods or it can be applied as an extrusion. In a preferred embodiment of the present invention, the binder 200 is extruded onto one of the webs and the primary web 100 and secondary web 300 are
20 immediately pressed together using rollers to bond their surfaces together. The binder 200 can be a thermoplastic adhesive, such as plasticized vinyl acetate/vinyl chloride copolymers or the binder 200 can be an emulsion of acrylics. The binder 200 can also be an extruded adhesive, such as polyethylene and ethylene copolymers. Low density polyethylenes are preferred extrusion adhesives.

TABLE 2
LAMINATE FILM STRUCTURES

Film No.	Three Layer Film Structure (Primary Web)	Binder (Adhesive)	Second Film (Secondary Web)
6	Film No. 1	PE	VM-PP
7	Film No. 3	PE	VM-PP
8	Film No. 5	PE	VM-PP
9	Film No. 3	PE	PVDC coated OPP

5 **Where:** **PE:** Chevron 1017 polyethylene

VM-PP: Vacuum metallized polypropylene film (Mobil 70 Met-HB
 or Himac VM-CPP2500)

PVDC coated OPP: Polyvinylidene chloride coated oriented polypropylene film

10 **EXAMPLE 1**

Table 3 lists twelve laminated film structures that were tested for primary bond strength between the primary web and the secondary web. The films in test runs 1 to 10 were fabricated in accordance with the present invention and the primary web of these films included a second outer layer containing a metallocene polyethylene. The films in test runs 11 and 12 were used as control films and the second outer layers of these films did not include a metallocene polyethylene. After the laminated film structures were fabricated, they were tested for primary bond strength.

Primary bond strength was measured by cutting a one inch wide strip from the laminate structures and peeling the primary web and the secondary web apart at 12 inches/min. and 180 degrees peel angle on an Instron tensile tester. The average peel force measured by the test is listed in Table as the primary bond strength.

TABLE 3
PRIMARY BOND STRENGTH
BETWEEN PRIMARY WEB AND BINDER

Test No.	Primary Web	Binder	Secondary Web	Primary Bond (g/2.54cm)
1	EPB-Chisso 7820/Fina 3371/Mobil ZCE 200	LDPE*	Mobil ZCE 200/Fina 3371/Chisso 7820	>200 (PE tear)
2	EPB-Chisso 7820/Fina 3371/Mobil ZCE 200	LDPE	PVDC coating/BOPP	>200 (PE tear)
3	EPB-Chisso 7820/Fina 3371/Mobil ZCE 200	LDPE	BOPP/PVDC coating	242
4	EPB-Chisso 7820/Fina 3371/Affinity PL 1840	LDPE	Affinity PL 1840/Fina 3371/Chisso 7820	528
5	EPB-Chisso 7502/Fina 3371/Affinity PL 1840	LDPE	Aluminum Vacuum Metallization/BOPP	227
6	EPB-Chisso 7502/Fina 3371/Mobil ZCE 200	LDPE	Aluminum Vacuum Metallization/BOPP	247
7	EPB-Chisso 7502/Fina 3371/Mobil ZCE 200	LDPE	Affinity PL 1840/Dowlex 2045A/Affinity PL 1840	482
8	EPB-Chisso 7502/Fina 3371/Affinity PL 1840	PU**	Affinity PL 1840/Dowlex 2045A/Affinity PL 1840	>500
9	EPB-Chisso 7502/Fina 3371/Affinity PL 1850	LDPE	Aluminum Vacuum Metallization/BOPP	230
10	EPB-Chisso 7502/Fina 3371/Exxon Exact 3034	LDPE	Aluminum Vacuum Metallization/BOPP	216
11	Control--EPB-Chisso 7502/Fina 3371/EPB-Chisso 7510	LDPE	Aluminum Vacuum Metallization/BOPP	60
12	Control--EPB-Chisso 7502/Fina 3371/Fina 3371	LDPE	Aluminum Vacuum Metallization/BOPP	10

* LDPE: Extrusion lamination grade Low Density Polyethylene

** PU: Polyurethane Solution Adhesive

5 The test results in Table 3 show that the films of the present invention with a
metallocene polyethylene in the second outer layer of the primary web had higher primary
bond strengths than the control films that did not have a metallocene polyethylene in the
second outer layer.

CLAIMS:

1. A film structure comprising:
a primary web comprising:
 - 5 (a) a first outer layer comprising a migratory additive;
 - (b) a second outer layer comprising a metallocene polyethylene and having an interior surface and an exterior surface; and
 - (c) a core substrate layer;wherein said core substrate layer is disposed between said first outer layer and said second
10 outer layer, and wherein said interior surface of said second outer layer is adjacent to said core substrate layer; and

a secondary web;

15 wherein said exterior surface of said outer layer of said primary web is laminated to said secondary web.
2. The film structure of Claim 1, wherein said migratory additive is selected from
20 the group consisting of silicone oil, polydialkylsiloxanes, polydimethylsiloxane, polyalkylphenylsiloxanes, olefin-modified siloxane oils, polyether-modified silicone oils, olefin/polyether-modified silicone oils, epoxy-modified silicone oils, alcohol-modified silicone oils, antiblocking agents, antistatic agents, and slip agents.
- 25 3. The film structure of Claim 1, wherein said migratory additive is a silicone oil having a viscosity of from 10,000 to 30,000 centistokes.
4. The film structure of Claim 1, wherein said metallocene polyethylene is selected from the group consisting of ethylene homopolymers, copolymers of ethylene and at least one
30 C₄-C₂₀ alpha-olefin, wherein said alpha olefin is polymerized using a single-site metallocene catalyst and has a molecular weight distribution (Mw/Mn) below 5.5 and a Melt Index at 190°C of from 0.3 to 20 dg/min.

5. The film structure of Claim 1, wherein said first outer layer further comprises a polyolefin selected from the group consisting of homopolymers of ethylene, propylene and butylene, and copolymers and terpolymers of ethylene, propylene and butylene.

5 6. The film structure of Claim 1, wherein said primary web is not treated with a primer prior to lamination.

7. The film structure of Claim 1, wherein said metallocene polyethylene comprises an additive selected from the group consisting of 0.2 to 20 weight % high density polyethylene, 10 1 to 6,000 ppm spherical antiblock, 1 to 6,000 ppm random shape antiblock, antistatic agents and slip agents.

8. The film structure of Claim 1, wherein said metallocene polyethylene is selected from the group consisting of linear low density polyethylene, very low density polyethylene, 15 ultra low density polyethylene, polyethylene plastomer and blends thereof.

9. The film structure of Claim 1, wherein said second outer layer further comprises a polyolefin selected from the group consisting of blends of 1% to 99% by weight of metallocene-based polyethylene and 99% to 1% by weight of Ziegler-Natta catalyzed ethylene 20 homopolymer or copolymer and homopolymers and copolymers of propylene and butylene

10. The film structure of Claim 1, wherein said core substrate layer comprises a polyolefin selected from the group consisting of oriented polypropylene, high density polyethylene, and blends of polypropylene and polyethylene.

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FIG. 1

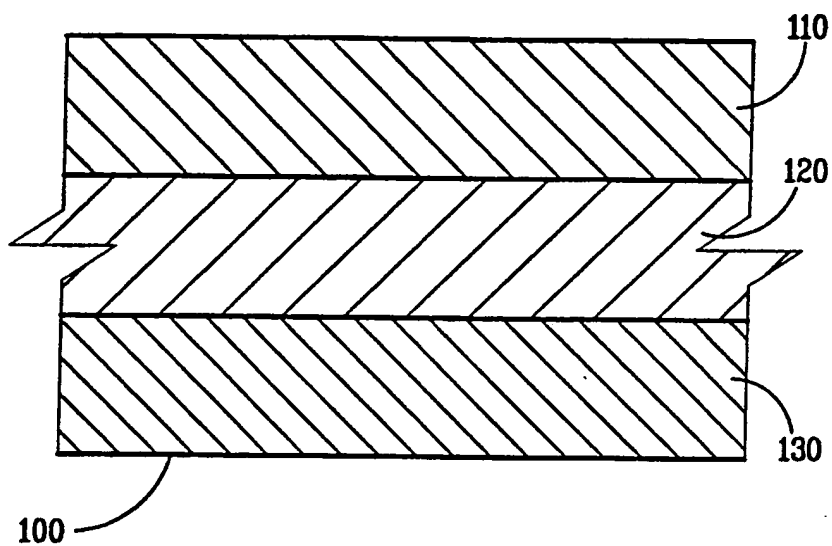
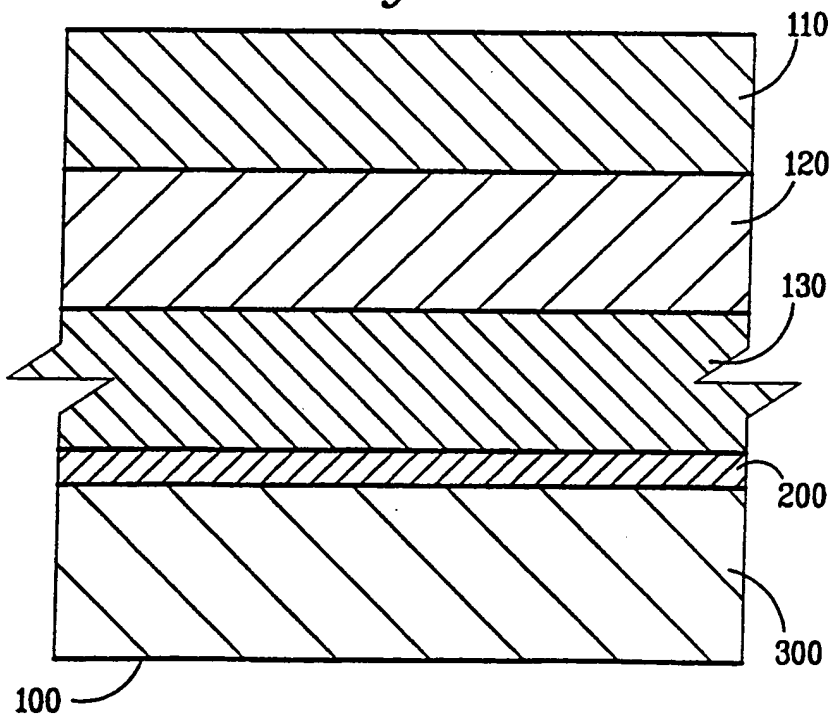


FIG. 2



INTERNATIONAL SEARCH REPORT

International application No.

PCT:US99/24845

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B32B 27/32

US CL : 428/447, 515, 516

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 428-447, 515, 516; 525/240; 526/348, 943

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

West: Metallocene or single site; silicone oil or siloxane or polysiloxane; slip near (additive or agent); Mobil.asn.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	US 5,874,139 A (BOSIERS et al.) 23 February 1999, see the entire document especially: column 7, lines 40-50; column 8, lines 40-59; column 15, lines 54+; and column 16, lines 30-54.	1, 2, 4, 5, 6, 7, and 10
X ---- Y	US 5,834,077 A (BARBOWICZ) 10 November 1998, see the entire document especially: column 12, lines 12-18; column 12, lines 43-51; column 21, table 1; column 23, lines 23+; column 24, lines 9-15 (single site catalysis); column 29, table VIII; and column 30, lines 59-65.	1, 2, 4, 5-8 ----- 3
Y ---- A	US 5,725,962 A (BADER et al.) 10 March 1998, column 3, lines 6-20; and column 6, lines 27-51.	3 ----- 1-2, 4-10

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
E earlier document published on or after the international filing date	*Y* document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*Z* document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means	
P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

02 FEBRUARY 2000

Date of mailing of the international search report

14 FEB 2000

 Name and mailing address of the ISA/US
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/24845

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,961,992 A (BALLONI et al.) 09 October 1990, see the entire document, especially column 2, lines 54+; column 3, lines 22-26, lines 40-48, and lines 61+; column 5, example 1, but note that the adhesive is a urethane material not a single site catalyzed polyethylene.	1-10
A	WO 95/21743 A1 (BRECK et al.) 17 August 1995, see page 14, lines 5-13; page 17, lines 30-40; page 18, and lines 1-15.	1-10